Class	Full Name	Index Number

bowen SECONDARY
I believe, therefore I am

PRELIMINARY EXAMINATION 2025

N

5105/5107/04

SCIENCE (CHEMISTRY)
Paper 4
Secondary 4 Normal Academic

Papers 3 and 4: 1 hour 15 minutes

Candidates answer on the Question Paper
No Additional Materials are required.

30 July 2025

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided.

Section B
Answer **one** question.
Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.
In calculations, you should show all the steps in your working, giving your answer at each stage.
You are advised to spend no longer than 30 minutes on Paper 3.
You may proceed to answer Paper 4 as soon as you have completed Paper 3.
A copy of the Periodic Table is printed on page 12.

At the end of the examination hand in your answers to Paper 3 and Paper 4 separately.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	**/ 22**
Section B **B……..**	**/ 8**
Total	**30**

This document consists of 11 printed pages, including the cover page and 1 blank page.

Section A

Answer **all** questions.

For Examiner's Use

A1 Choose from the substances listed to answer the questions.

calcium hydroxide
sodium hydroxide
calcium chloride
carbon dioxide
ammonia
hydrogen
oxygen
water
neon

Each substance may be used once, more than once or not at all.

Identify the substance which

(a) extinguishes a lighted splint with a 'pop' sound

…….. [1]

(b) is an unreactive element

…….. [1]

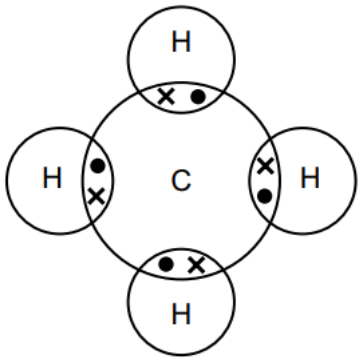
(c) is added to soil to control its acidity.

…….. [1]

[Total:3]

For Examiner's Use

A2 A compound Y contains only carbon and hydrogen. The diagram shows the bonding in Y. Only the outer electrons are shown for each atom.



(a) Name compound Y.

…… [1]

(b) State the type of bonding present in Y.

…… [1]

(c) Compound Y can be used as a fuel.
Name the gas produced when Y burns in a limited supply of air.

…… [1]

(d) Hydrogen, H_2, can also be burned as a fuel. Explain why it is less harmful to the environment to burn hydrogen than compound Y.

……

…… [1]

[Total:4]

A3 Alkenes are a homologous series of unsaturated hydrocarbons.

(a) State the general formula of alkenes.

…… [1]

(b) In addition to having a general formula, state another characteristic of compounds in the same homologous series.

…… [1]

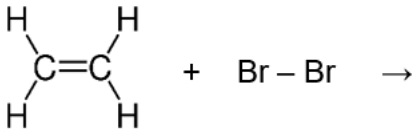
For Examiner's Use

(c) Ethene reacts with bromine under room conditions.

(i) Name this type of reaction.

…… [1]

(ii) Complete the following equation to show the full structural formula of the product formed in this reaction. [1]



(iii) State the colour change of the reaction mixture in **(ii)**.

The colour changes from ……..… to ……..……. [1]

(iv) Besides ethene, ethane can also react with bromine.
State a condition required for this to happen.

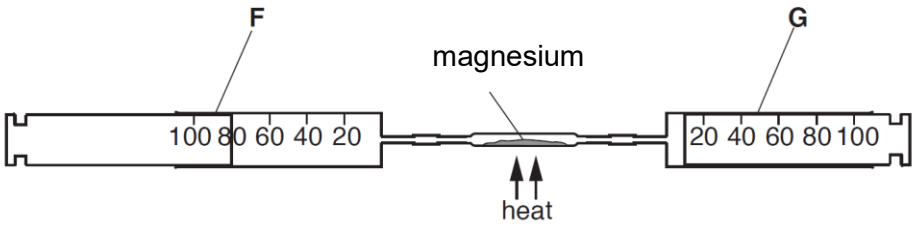
…… [1]

(v) Write the balanced chemical equation for the complete combustion of ethene, state symbols are not required.

…… [1]

[Total: 7]

A4 A student attempts to determine the percentage of oxygen in the air using the apparatus shown.



At the start of the experiment there is 90 cm^3 of air in the apparatus. The air is passed backwards and forwards between gas syringes F and G over the heated magnesium.

This is repeated until the volume stops decreasing. The gas is allowed to cool to room temperature and the final volume is measured.

The magnesium reacts with the oxygen in the air to produce solid magnesium oxide. An excess of magnesium is used to ensure all the oxygen in the air is reacted.

(a) Name two gases that are present in the final volume of gas after all oxygen has reacted.

1 ……

2 …… [2]

(b) State the electronic configuration of an oxygen atom.

…… [1]

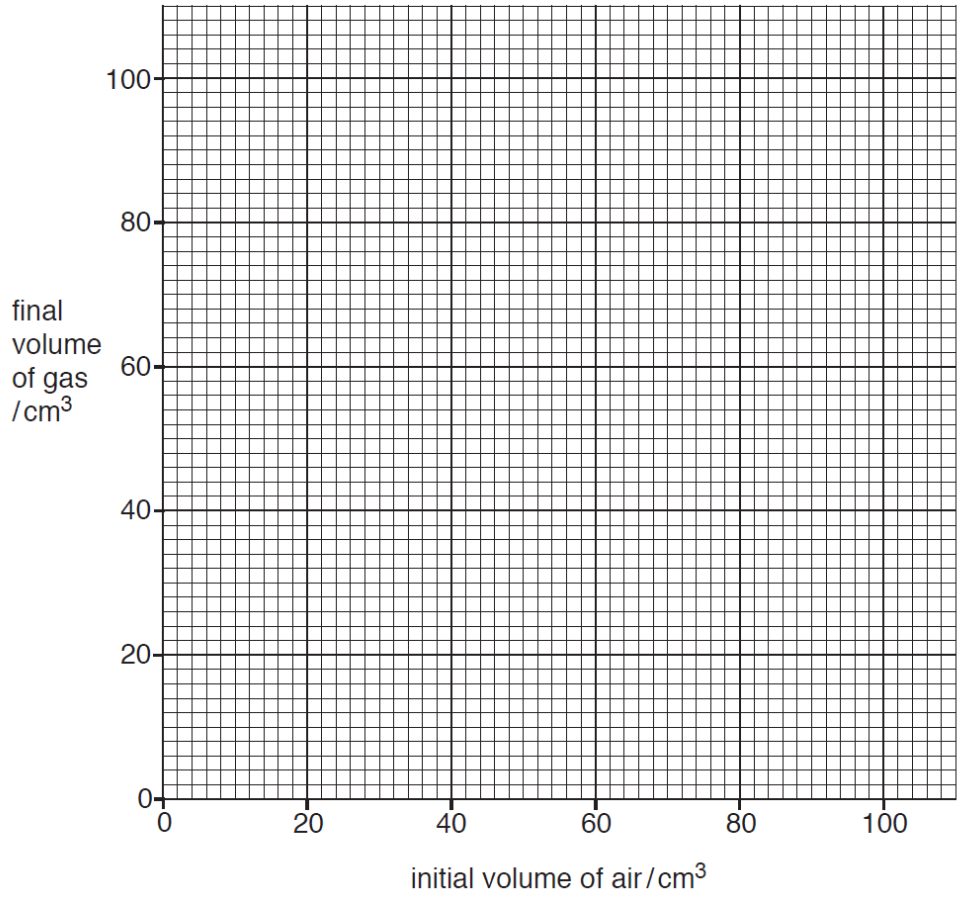
(c) Draw a 'dot-and-cross' diagram to show the bonding present in magnesium oxide. Show only the outer-shell electrons. [2]

(d) The student repeats the experiment several times using different initial volumes of air in the apparatus. An excess of magnesium is used in each experiment.
The results are shown in the table.

initial volume of air / cm^3	final volume of gas / cm^3
90	71
70	55
60	47
50	39
40	31
20	16

For Examiner's Use

Plot a graph of the final volume of gas against the initial volume of air. Mark each point with a cross (x). Draw a line of best fit taking into account all your plotted points. [2]



(e) Use your graph to determine the final volume of gas if the student uses 80 cm^3 as the initial volume of air.

answer ..... cm^3 [1]

[Total: 8]

Section B

Answer **one** question from this section.

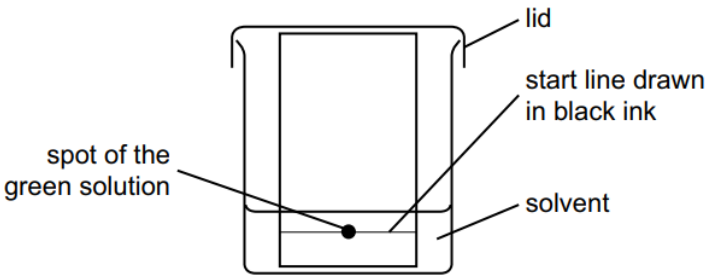
For Examiner's Use

B1 **(a)** A student wants to separate the coloured pigments in a plant leaf by chromatography. The student grinds the plant leaf and separates the solids from the green solution.

Identify the method used to separate the solids from the green solution.

…… [1]

(b) The student sets up the chromatography apparatus shown. The student made two mistakes.



One mistake was to add too much solvent so that the start line was in the solvent.

(i) Explain why this mistake would not lead to the separation of coloured pigments.

……

…… [1]

(ii) Identify the second mistake and suggest how this mistake would be corrected.

mistake ……..

correction ……..

[1]

The mistakes were corrected, and the final chromatogram is shown.

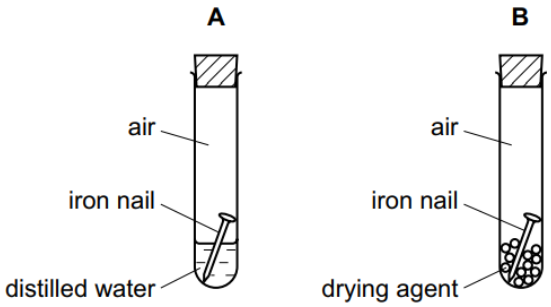
(iii) State the number of different pigments present in the green solution.

…… [1]

[Turn over

(c) Another student does an experiment to investigate the rusting of iron nails.

For Examiner's Use



(i) Each iron nail has a mass of 1.4 g. Calculate the number of moles of iron in an iron nail.

number of moles ..... mol [1]

(ii) Explain how an iron atom forms an iron(II) ion, Fe^{2+}.

..... [1]

(iii) Predict, with reasons, whether the nail in each tube will rust.

Does the nail rust in tube A? .....

reason .....

.....

Does the nail rust in tube B? .....

reason .....

.....

[2]

[Total: 8]

For Examiner's Use

B2 Aluminium, iron and potassium are metallic elements. Aluminium and iron are widely used, but no useful objects can be made out of metallic potassium.

aluminium alloys are used in aircraft

iron is used to make steel for cars

(a) (i) State one property of a metallic element which is different from a non-metallic element.

……

…… [1]

(ii) Use your knowledge of the metals in Group 1 of the Periodic Table to state **one** reason, other than cost, why no useful objects can be made out of metallic potassium.

……

…… [1]

(b) Iron reacts readily with dilute hydrochloric acid to form iron(II) chloride, $FeCl_2$.

(i) Explain what is meant by an acidic solution in terms of the relative concentrations of hydrogen ions, H^+ , and of hydroxide ions, OH^- .

……

…… [1]

(ii) Construct a chemical equation for the reaction of iron with dilute hydrochloric acid to form iron(II) chloride.

…… [2]

(iii) Iron(III) oxide also reacts with dilute hydrochloric acid. In a reaction, 10 mol of Fe_2O_3 is used. Calculate the mass of Fe_2O_3 used.

mass = …… g [2]

(c) A student carried out experiments to determine the order of reactivity of four metals. He placed a sample of each metal in the four solutions shown in the table. He recorded the results in the table.

solution \ metal	copper	zinc	silver	magnesium
copper(II) nitrate	x	✓	x	✓
zinc nitrate	x	x	x	✓
silver nitrate	✓	✓	x	✓
magnesium nitrate	x	x	x	x

key

✓ reaction took place

x no reaction

List the four metals in order of decreasing reactivity.

most reactive ……..

……..

……..

least reactive …….. [1]

[Total: 8]

- End of paper -

BLANK PAGE

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key: proton (atomic) number; atomic symbol; name; relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium –	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 139	58 Ce cerium 140		60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232		92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).
The Avogadro constant, $L = 6.02 \times 10^{23}\ mol^{-1}$.